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ABSTRACT

This study investigated place location learning from a simulated environmental exploration experience in terms of two variables: gender (both cognitive and affective effects) and presence and/or type of accompanying map. Subjects were 120 fourth and fifth grade students, who were randomly selected and assigned after stratification on gender. The students played a computer adventure game--Winnie the Pooh in the Hundred Acre Wood--for 40 minutes with either a labels-plus-drawings map, a labels-only map, a drawings-only map, or no map at all. Contrary to findings from previous studies of gender differences in spatial abilities, spatial skills, and attitudes toward computer activities (most of which reported results favoring boys), no significant differences regarding gender were found for either the cognitive or affective measures, and virtually all subjects enjoyed playing the game. As hypothesized, results showed that map groups scored significantly higher on a place location recall posttest than the no-map group, and that labels-plus drawings and labels-only groups outscored the other groups to a statistically significant degree. Follow-up tests 2 weeks after treatment showed high levels of retention of place location information. It is concluded that computer adventure game simulations of environmental exploration may represent an effective and enjoyable method for promoting place location learning for both sexes. (Author/DJR)

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APPLICATIONS OF MICROCOMPUTER SEARCH-TYPE ADVENTURE GAMES IN RESEARCH ON SPATIAL ORIENTATION, PLACE LOCATION, AND MEMORY FOR PLACES

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APPLICATIONS OF MICROCOMPUTER SEARCH-TYPE ADVENTURE GAMES IN RESEARCH ON SPATIAL ORIENTATION, PLACE LOCATION, AND MEMORY FOR PLACES

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Introduction

This paper describes my doctoral dissertation study in Instructional Technology (Utah State University, conducted March-August 1985) and the research agenda set by it. Central to both is the "computer adventure game," a computer-based simulation game involving a search in a hypothetical spatial setting, i.e., a form of "treasure hunt." As a game, it is designed to be both challenging and enjoyable. Obstacles confront the player in his or her quest; successful progress requires decision-making, gathering and interpreting of clues, problem-solving, and negotiating mazes. The adventure game combines the characteristics of "intellectual puzzle, traditional narrative, and fantasy role game" (Dickson & Raymond, 1984). The player chooses the route to be traveled, sometimes with the aid of an accompanying map or narrative booklet, sometimes without. Usually, the game provides for a degree of interactive "dialogue" between player and characters in the game. The recent emergence of the microcomputer, with its memory storage, processing, branching, and graphics capabilities, has vastly increased the scope of adventure games.

The activity involved in the computer adventure game used in this study is defined as simulated exploration of an environment. This term connotes the simulation of active and purposive travel or navigation, not a passive, "guided tour" travel experience. The environment explored in the computer game simulates a large-scale environment , i.e., one which cannot be seen or perceived in its entirety without traveling about.

The Study

Abstract

Place location learning from a simulated environmental exploration experience was investigated in terms of two variables: gender (in terms of both cognitive and affective effects) and presence/type of accompanying map. One hundred and twenty 4th and 5th grade students, randomly selected and assigned after stratification on gender, played a computer adventure game for 40 minutes with either a labels-plus-drawings map, a labels-only map, a drawings-only map, or no map. Contrary to findings from previous studies of gender differences in spatial abilities, spatial skills, and attitudes toward computer activities (most of which reported results favoring boys), no significant differences regarding gender were found in this study for either the cognitive or affective measures. Virtually all subjects enjoyed playing the game. As hypothesized, results showed that map groups scored significantly higher on a place

location recall posttest than the no-map group and that the labels-plus-drawings and labels-only groups outscored the other groups to a statistically significant degree. Follow-up tests two weeks after treatment showed high levels of retention of place location information. It is concluded that computer adventure game simulations of environmental exploration may represent an effective and enjoyable method for promoting place location learning, for girls as well as boys.

Introduction

This study represents a point of convergence for several distinct and heretofore non-intersecting entities: an instructional need, a technological innovation, and three lines of research.

The Joint Committee on Geographic Education of the National Council for Geographic Education (NCGE) and the Association of American Geographers (AAG), in their Guidelines for Geographic Education (1984), list "place location" as the first "fundamental theme" in geography. As the authors state: "The first task in geography is to locate places, describing and explaining their physical (natural) and human characteristics" (p. 2). Although certainly no geography educator would contend that place location comprises the totality of geography education, there is general agreement that such knowledge forms a basic part of that curriculum and is requisite to further learning in the discipline and in the social sciences generally.

Unfortunately, despite its importance, adequate place location knowledge is not widespread. Prominent among the several "illiteracies" which afflict American schoolchildren is "geographic illiteracy," usually evidenced by the inability of the "illiterate" to indicate the correct relative locations of significant places on a world map or globe. As reported in both the popular media and the professional literature, survey studies abound which decry the place location ignorance of Americans at various age levels (e.g., Grosvenor, 1985; Helgren, 1983). According to one such survey, more than 20% of 12-year olds questioned could not locate the United States on a world map and a similar percentage incorrectly identified Brazil as the United States (NCGE & AAG, 1984). Place location ignorance in this country is not a recent phenomenon (e.g., Fine, 1951), but many believe it is becoming a more critical problem as the need for international understanding grows in an increasingly global society (American Council on Education, 1984).

Although there has been little research into actual classroom practice in geography, the principal means of effecting place location learning in formal education appears to be the study of cartographic maps, specifically the memorization of places on maps (Kincheloe, 1984). Although pedagogy based on memory research and principles can be both efficient and effective, too often in the hands of unskilled teachers it becomes drudgery in the form of mere rote memorization. Moreover, there is mounting evidence that the teachers' own knowledge of place location may be very low (Herman, Hawkins & Berryman, 1985). Especially abhorrent to many geography educators is the fact that memorization of places has become the stereotype for the whole of geography education. The average person, says Gritzner (1981), remembers geography as "a rather sterile course" from the middle grades that was "little more than an exercise in memorization—a load on the memory rather than a light in the

mind" (p. 265). And geography as an academic subject can ill afford an image problem. Since the 1930s, it has become ever more deeply buried in the "social studies" amalgam. Frequently the subject is relegated to ill-prepared or untrained teachers, with poor teaching the result (James, 1971).

Current teaching methods in geography have affective as well as cognitive costs. McTeer (1979) cites the emphasis on memorization to explain his finding that high school students in Georgia rated geography as their least-liked social science subject. Several authors have remarked on the natural curiosity and interest children have in learning about new places (e.g., Blaut & Stea, 1969). Unfortunately, the learning methods they are talking about are extracurricular. In formal education, that natural curiosity seems too often to have been stifled by poor teaching.

Alternatives to passive map study and memorization as the means to place location knowledge have been suggested. Educators since Froebel have argued for an experiential approach in formal spatial learning. Children, under a teacher's guidance, are urged to get out and explore their immediate environment and community, creating maps and models from their experiences (e.g., Frazee, 1984). However, most of the recommendations for the experiential approach have dealt with map skills learning or general spatial skills development, and not with place location.

Evidence from environmental psychology supports the effectiveness of place location learning by means of the experiential approach. Place location is a part of the "cognitive mapping" or spatial representation process which is universal among humans and present throughout virtually the entire life-span (Downs & Stea, 1977). Critical to such cognitive map fomation is active exploration of the environment, involving movement in space which is goal-directed (Hart & Moore, 1973). Unfortunately, the impediments to the use of such a "natural" method of place location learning in the classroom are considerable. Generally, it is not feasible within the confines of formal education to visit the distant places whose locations are to be learned.

Simulated travel involving active exploration of the environment is just beginning to be studied, largely by the military in investigating spatial behavior and general spatial abilities development. Preliminary findings show such a procedure to be effective in fostering place location learning, an effective simulation of the "natural" experience (Goldin & Thorndyke, 1981). Simulated travel has occasionally been recommended as a teaching technique for the classroom (e.g., McNamara, 1975). However, this simulation has involved passive travel, e.g., a narrative "guided tour," and not active exploration , i.e., choosing of routes and interacting with "places." Although not as prohibitive as live travel to distant places, simulated exploration of distant environments has until recently been too expensive and time-consuming to be feasible in the classroom.

A currently popular genre of computer game, the search-type adventure game, appears to offer an inexpensive yet accurate simulation of active environmental exploration. Typically, the game involves a search along the lines of a "treasure hunt," in which the player chooses a travel route among places represented by pictures on the monitor screen. Sometimes an accompanying map is provided for reference to aid in the search. The player learns something about each place visited, through reading

information provided on the screen or asking questions which are answered on the screen.

It was reasoned that the computer adventure game, as a simulation of active, purposive exploration of an environment, could be an effective vehicle for place location learning. In fact, informal pilot-testing by the investigator showed that at least one such game, representative of the genre, was remarkably effective in teaching place location, in addition to being fun to play.[1] Although the places depicted in this game (and most others) were fictitious, it was felt that the game might represent a powerful model for similar instructional materials designed specifically to teach the location of real-world places. As a simulation of active travel among places, the game merited study with regard to place location learning. Research reporting on the motivational appeal of such computer games (e.g., Lepper, 1985) strengthened the argument favoring an investigation.

This study grew out of existing research in three areas of inquiry which previously had rarely, if ever, been considered together: gender differences in spatial ability, and gender differences regarding computers, and learning from maps.

The body of research concerning gender differences in general spatial ability is large (cf. Maccoby & Jacklin, 1974). A smaller number of studies has focused on gender as a variable in investigations of topics closer to classroom geography, such as map use and place location knowledge (e.g., Gilmartin & Patton, 1984; Saveland, 1980). A few studies in environmental psychology have found gender differences in cognitive mapping and spatial learning from the environment (e.g., Hart, 1979). The great majority of these studies report superior performance by males. Prior to the present study, however, no research had considered gender differences in place location learning resulting from a computer game simulation of environmental exploration.

A second line of research interwoven in this study is that regarding gender differences in affect toward use of computers. In particular, studies have found that boys and girls have different attitudes toward computer games (e.g., Lepper, 1985). As with spatial abilities research, most studies found that boys have more interest in computer activities in general and evince a more positive attitude toward computer games than girls do. This study investigated gender differences in attitude toward perhaps a different kind of computer game than had been studied before.

Research in spatial learning in general and place location learning in particular has demonstrated the value of maps in these activities. Several studies have investigated the relative utility of various kinds of maps, such as labeled maps, maps with drawings of the referents, and labels-plus-drawings maps (e.g., Kulhavy & Schwartz, 1980; Kulhavy, Schwartz & Shaha, 1983). These studies, based on Paivio's "coding redundancy hypothesis" (Paivio, 1974), found that place location recall is most aided by maps which are rich in information codes, such as labels-plus-drawings maps. Prior to the present study, however, research had been lacking with regard to simulated environmental exploration of the kind represented by computer adventure games. This study attempted to fill that void by examining the effects of both map presence and map type on the degree of place location learning resulting from a computer game travel simulation activity.

In summary, it was the intent of the present study to begin a research agenda focused on place location learning as facilitated by the

computer adventure game, representing simulated exploration of the environment, by focusing on two variables—gender as related to cognitive measures and affect, and presence/type of accompanying map--which had not previously been investigated together. The population selected for study was fourth- and fifth-grade students, as it is at those levels in formal education where place location learning is generally first introduced (Herman, 1983).

In addition to describing the three lines of research which converged on this study, it is important to mention one which did not. Media comparison research in education has proven inconclusive, perhaps even futile, as Wilkinson (1980) explains in his comprehensive review of the literature. If variables are not controlled carefully in such studies, valid conclusions cannot be drawn. On the other hand, if all extraneous variables are controlled, the experiences being compared become so contrived as to make generalizations to practical application unwise.

This study was not intended to be a direct comparison between simulated environmental exploration in the form of a computer adventure game as a means of place location learning and another method such as traditional, passive map study. Rather it was a study of two variables which may be critical to assessing the success of place location learning via one novel means, the computer adventure game simulation. The success of this learning method must be measured in terms of both cognitive and affective components, for the instructional need described earlier has both cognitive and affective dimensions. This study used both measures in investigating the main factors. It was reasoned that conclusions regarding these factors might be important in determining the most effective design and ultimate utility of this method in the classroom.

Method

Two experimental variables were arranged in a 2 x 4 mixed model factorial design. The first factor was subject gender . The second factor, map condition, consisted of four levels: (a) maps with labels plus facsimile drawings of on-screen images; (b) labels-only maps; (c) drawings-only maps; and (d) no map. Figure 1 shows a reduced copy of the labels-plus-drawings map.

Subjects for the study were 120 fourth- and fifth-grade students randomly selected, after stratification based on gender, from the classes at Hillcrest Elementary School in Logan, Utah. They were felt to represent a small-town, Caucasian, middle- to upper-middle-class population. Subjects were randomly assigned to treatment, 15 per cell.

The simulation game used in the study was Winnie the Pooh in the Hundred Acre Wood (Lowe & Walt Disney Associates, 1984), chosen for its simplicity and accurate representation of the generic type of computer adventure game. In it, the player "searches" for objects in a simulated environment of 30 "places" shown by on-screen graphics, choosing his own route of travel from place to place (Figure 2). A degree of "interaction" with each place is possible, simulating exploration in a real-world setting.

Subjects played the game individually for 40 minutes under one of the map conditions, after which each subject completed a place location recall test consisting of putting markers, representing places, on a blank outline map. Affective responses toward the simulated exploration experience were collected from a post-treatment questionnaire. Two weeks after treatment, subjects were given the same place location posttest as a

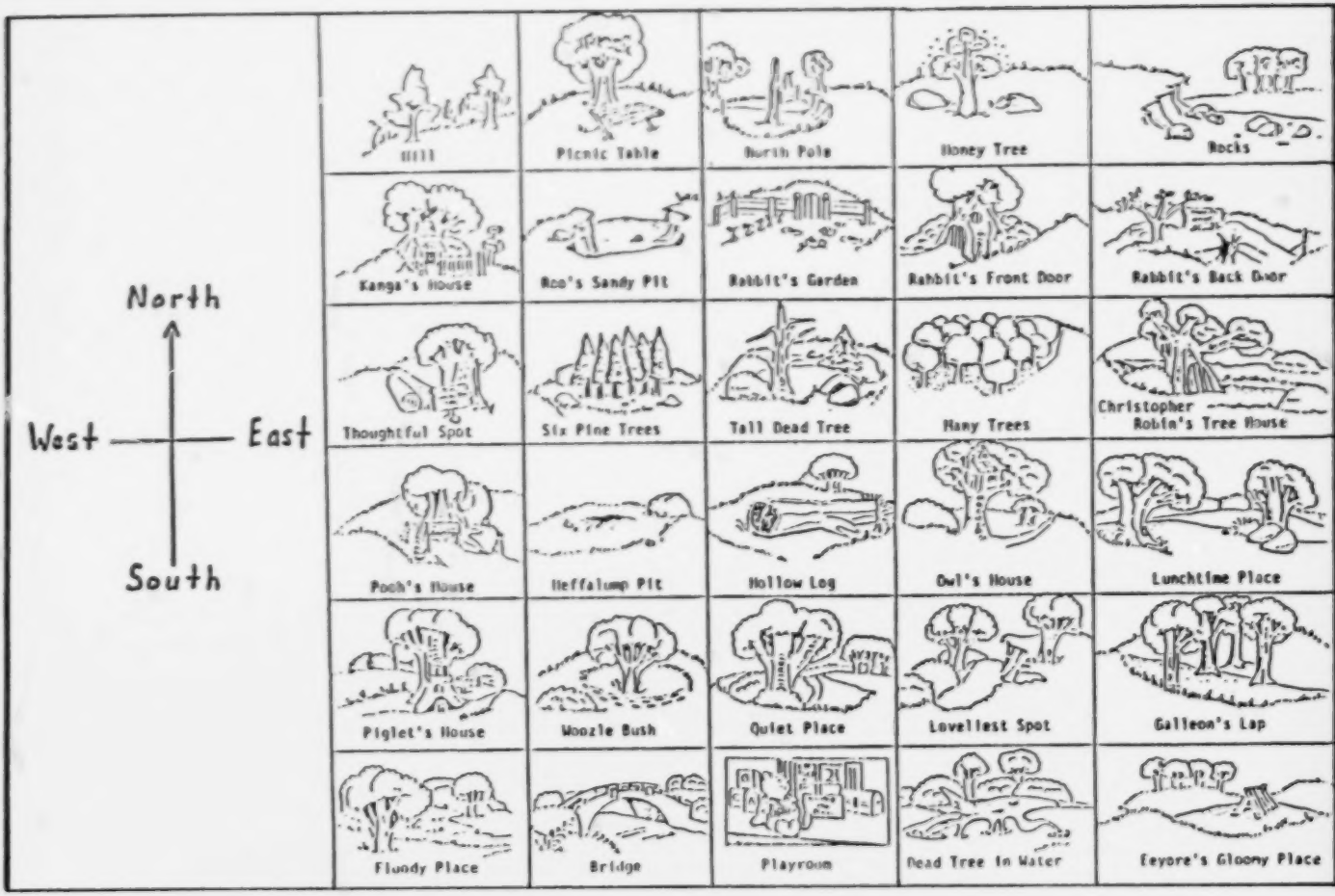

Figure 1. Labels-plus-drawings treatment map. (Original size--11x17 inches)

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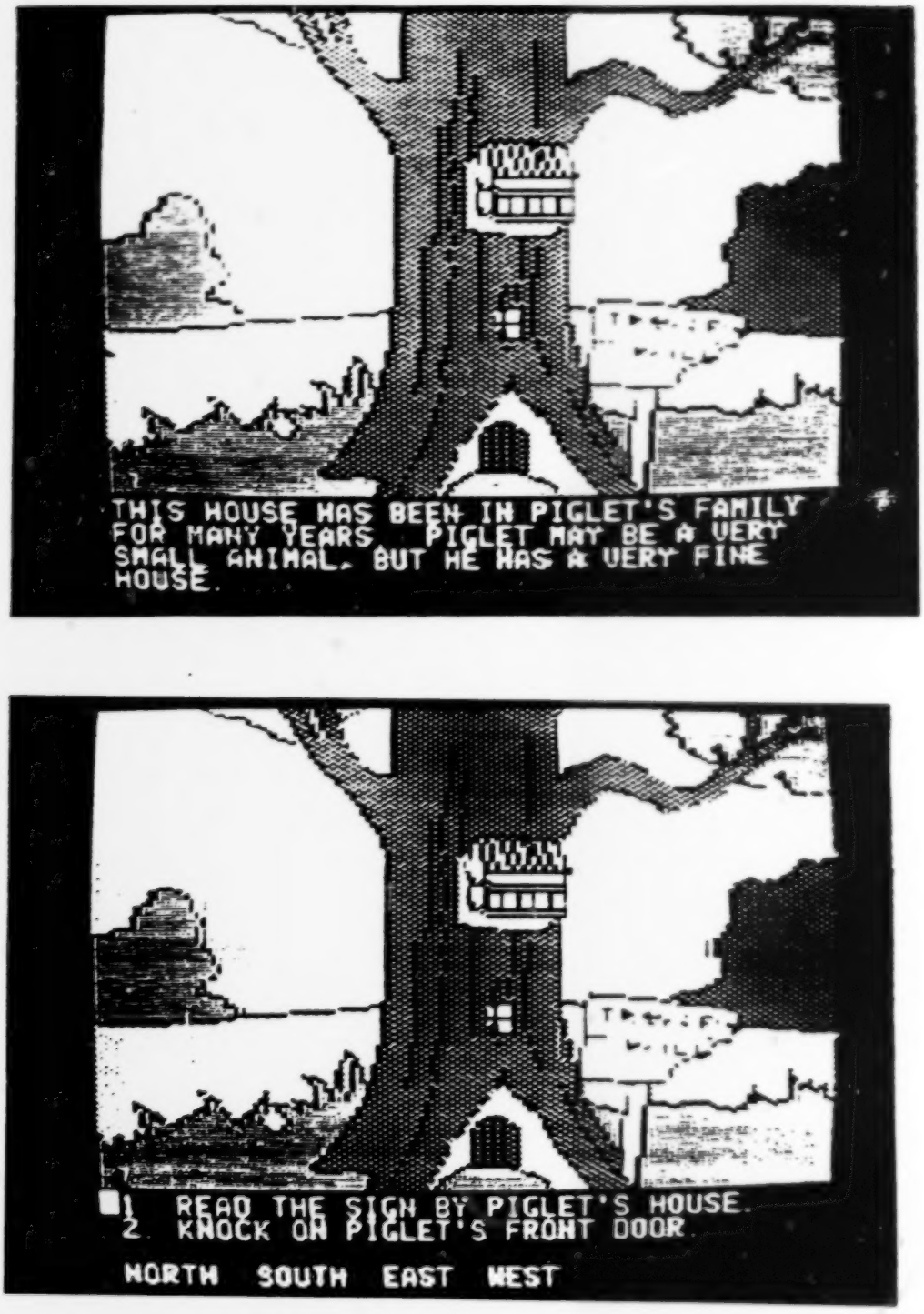
THIS HOUSE HAS BEEN IN PIGLET'S FAMILY FOR MANY YEARS. PIGLET MAY BE A VERY SMALL ANIMAL, BUT HE HAS A VERY FINE HOUSE.
1. READ THE SIGN BY PIGLET'S HOUSE.
2. KNOCK ON PIGLET'S FRONT DOOR.
NORTH SOUTH EAST WEST

Figure 2. Successive graphics "frames" from computer game.

follow-up to measure long-term retention. Data were collected not only by means of tests and questionnaires, but also by means of videocassette recorders connected to each computer.

Based on previous research in related fields, several hypotheses were advanced. It was hypothesized that boys would score higher on the posttest and follow-up test than girls. Based on research on affect regarding computer activities, it was hypothesized that boys would enjoy the computer adventure game experience more than girls. Regarding the effect of the accompanying map, it was hypothesized that subjects using maps would score higher on the posttest and follow-up test than subjects without maps and that subjects using labels-plus-drawings maps would outscore those in all other map conditions. A secondary hypothesis stated that boys would visit more places in the game than girls, based on spatial behavior research showing that boys, in their play, explore a broader spatial range than girls (Hart, 1979).

Results and Discussion

Results showed no significant gender differences on posttest scores (see Tables 1 and 2). This is especially surprising in light of the fact that post hoc analysis of several personological variables showed that boys had significantly more computer experience than girls. However, boys did score significantly higher than girls in the labels-only map group. Boys also scored significantly higher than girls on the follow-up test. Gender x Map Condition interactions were not significant on posttest scores. Boys visited more places in playing the game than girls did, but not to a statistically significant degree ($F=1.34$, $df=1$, $p>.05$).

Concerning the affective measure, both boys and girls overwhelmingly enjoyed the simulated exploration experience. More than 93% of all subjects indicated that they liked the computer game "a lot" and 91% indicated that they would definitely like to play the game again sometime. Chi-square analyses of gender and affect showed no statistically significant association. Nor was affect found to be associated with map condition. Tables 3 and 4 present these results. The lack of a significant finding regarding gender and affect may be due to the non-violent, non-sexist nature of the computer game used in the study, as previous studies reporting a gender difference had investigated highly competitive, "high action" (i.e., involving violence) games, usually with male protagonists. The extent to which the novelty effect may have influenced results is unknown.

Concerning the cognitive measures, analyses of variance and Newman-Keuls post hoc comparisons showed that subjects in all map groups scored significantly higher than subjects without maps, and that subjects using labels-plus-drawings or labels-only maps scored significantly higher than subjects using drawings-only maps (Tables 1 and 2). Contrary to expectations, the difference between labels-plus-drawings and labels-only groups was not significant. The difference between labels-only and drawings-only group means, and the lack of difference between labels-only and labels-plus-drawings group means conflict with the coding redundancy hypothesis of Paivio and the research findings of Kulhavy and colleagues. Differences in the nature of the stimulus experience (simulated exploration with maps vs. verbal learning or map study alone) are offered by way of explanation for the discrepancies. Analyses using an "accuracy index" (ratio of places correctly located to total places visited) showed the cognitive results to be independent of the number of places visited.

Table 1
Analysis of Variance: Mean Correct Locations Recalled on Posttest as a Function of Map Condition and Gender

Source	df	SS	MS	F
Map Condition	3	2672.23	890.74	28.98***
Gender	1	42.01	42.01	1.37
Interaction	3	137.69	45.90	1.49
Within (error)	112	3442.00	30.73	
Total	119	6293.93		

*** $p<.001$
η^2 (Map Condition) = .42
η^2 (Gender) = .01
η^2 (Interaction) = .02

Table 2
Mean Correct Locations Recalled on Posttest as a Function of Map Condition and Gender

	Map Condition				
Gender	Labels + Drawings	Labels Only	Drawings Only	No Map	M
Boys	13.00	15.27	7.87	1.13	9.32
Girls	12.67	10.40	7.93	1.53	8.13
M	12.83	12.83	7.90	1.33	

Table 3
2 x 2 Contingency Table for Affect by Gender

	Affect[a]		
Gender	Liked Game a Little	Liked Game A Lot	
Boys	5 (4)[b]	55 (56)	60
Girls	3 (4)	57 (56)	60
	8	112	120

χ^2 = 0.13 (after Yates' Correction), df = 1, p>.05

[a] As there were no negative responses, those cells are not included in the table.

[b] Numbers enclosed in parentheses are expected frequencies.

Table 4
2 x 2 Contingency Table for Desire to Play Again by Gender

	Desire to Play Again		
Gender	Maybe	You bet!	
Boys	6 (4.5)	54 (55.5)	60
Girls	3 (4.5)	57 (55.5)	60
	9	111	120

χ^2 = 0.48 (after Yates' Correction), df = 1, p>.05

Post hoc analysis of the number of times subjects tried during play to travel out of the environment represented in the game showed that all map groups did indeed use their maps, a finding corroborated by observation.

Conclusions

From the results of this study, it is concluded that computer adventure game simulations of environmental exploration, especially non-violent, non-sexist games using labels-plus-drawings or labels-only accompanying maps, may represent an effective and enjoyable method for promoting place location learning for both boys and girls of the ages studied. The no-difference finding regarding gender on the cognitive measure is encouraging, in light of findings from previous research on spatial learning via other means showing superior performance by males. That such "gender equity" was also found on the affective measure is especially satisfying. Replications of the present study focusing on specific personological variables (e.g., age, computer experience), with different populations (e.g., urban), and controlling for novelty, are recommended.

The potential of computer adventure games in helping students learn the locations of real-world places seems worthy of further investigation. At the time this study was conducted, no computer adventure game existed which invloved simulated travel among real-world places. Now several such games are available commercially.[2] As with all computer adventure games, the player of these games is placed in control of his learning and is isolated from his peers during the learning process (although the games can be played by small groups as well as individually). Clearly such an "environment for learning" raises questions regarding the teacher's role and the socialization aspect of formal education. However, given that place location knowledge on the part of teachers is often quite low and that enthusiasm on the part of both teachers and students for "traditional" basic geography learning is often lacking, perhaps the teacher's central role may justifiably be usurped by a highly motivating and pedagogically effective game in this instance. Moreover, in addition to teaching place location, there is growing evidence from the literature that computer adventure games may improve the player's note-taking skills, observational skills, map use skills, and general problem-solving abilities (e.g., Hayes, Lancy & Evans, 1984). Questions of the efficiency of place location learning from computer adventure games should be addressed in future studies.

Research Agenda for the Future

Two specific studies are planned which will make use of the spatial exploration data collected on videotape from the present study. The first will examine active simulated exploration of an environment (i.e., playing the interactive computer adventure game) versus a passive "tour" of the same environment (i.e., viewing the videotape from a playing of the game). The use of videotapes from the present study with subjects matched as to gender and map type should permit an unusual degree of experimental control and heightened focus on the active-passive dimension. The second anticipated study will analyze data from the present study in order to identify factors contributing to why the locations of certain places are remembered better than others (e.g., number of visits to the place, degree

of "interaction" with the place) and to investigate how subjects differ in their patterns of environmental exploration.

Results of the present study suggest that computer adventure games, as simulated travel experiences, may represent not only an intriguing "environment for learning," but also a promising "vehicle" for various types of types of spatial behavior research. It has been remarked elsewhere (e.g., Hooper, 1981) that research on spatial behavior and learning is often impeded by the lack of appropriate, practical models of travel in real space. Computer adventure games, and more sophisticated extensions of them such as interactive videodisc simulation games, offer promise in this area. One of the advantages of such a research vehicle is that data may be faithfully and completely recorded--and even analyzed--by the vehicle itself. In the present study, attaching the computers used to videocassette recorders provided a complete visual record of each subject's "travels" for later analysis.

The value of computer adventure games to spatial or other forms of learning and to research on spatial behavior/learning will ultimately be determined by the particular situation of their intended use. However, at least with regard to place location learning and other basic geography education they appear to deserve inclusion in the teacher's panoply of instructional materials and in the school's "environments for learning." The degree to which this is generalizable beyond this particular subject matter and point in time are debatable. Finally, because computer adventure games are almost certainly more frequently found in homes than in schools, they extend the "environments for learning" concept beyond the bounds of formal education. But that is another study.

ENDNOTES

1. The investigator's interest in this game, entitled Winnie the Pooh in the Hundred Acre Wood (Lowe & Walt Disney Associates, 1984), was first aroused when he observed a 7-year-old girl of normal intelligence and minimal computer experience play the game for an hour an a half without a break. After the game, she was able to draw from memory a detailed map of the environment explored in the game which correctly located all 30 places comprising that environment! Eight weeks later, having had no contact with the game in the meantime, she correctly located 15 of the 30 places on an outline map, drawing accurate pictures of 12 of them. Similar "pilot tests" with three other children and two adults in their thirties produced comparable results. All players indicated that they greatly enjoyed playing the game.

2. The following are examples of new computer adventure games involving real-world locations: Where in the World is Carmen San Diego? by Broderbund, Cross Country USA by Didatech, Agent USA by Scholastic, Flight Plan by Science Research Associates.

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